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A MACHINE FOR SEPARATING MOSQUITO EGGS FROM SOIL

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Affecting Man and Animals

In a study of the factors affecting the hatching of eggs of several species of Aedes mosquitoes it became necessary to use large numbers of these eggs. They were first obtained by placing fed females in cages and allowing them to lay eggs on moist cellucotton placed in the bottom of the cages. This method was unsatisfactory because of the amount of work involved in capturing and caring for the females and because eggs could be obtained only during the mosquito season when females were available. It was also found that in captivity some species laid only a small number of eggs and that a considerable proportion of the eggs from other species were infertile.

Several phases of our studies made it desirable to use eggs that had been exposed to natural environmental conditions. Such eggs can be recovered from mosquito-breeding areas by gathering up the top layer of soil and debris in which the eggs are laid.

For our work it was necessary that the eggs be separated from this soil and debris, and a machine for this purpose was therefore developed from a grain cleaner. This machine separates nearly all of the soil and debris from the eggs. The eggs can then be recovered from the remaining soil with the aid of a microscope. This is done by spreading the soil in a thin layer on a white surface and removing the eggs with a moistened camel's-hair brush.

A series of shaker screens, a roll screen, and an air blast are employed to separate the eggs from the soil in this machine. The material is placed in the hopper and as it feeds down over the shaker sieves the coarse material is removed by the 14-mesh, 30-mesh, and 40-mesh sieves. The eggs pass through these sieves, but they do not pass through the 80-mesh sieve below. This 80-mesh sieve removes the material which is smaller than the eggs. The eggs shake off this screen and drop down the opening to the roll sieve. On the way down the material is subjected to a breeze from the fan which removes the light particles. The turning motion of the roll

causes the eggs to pass through the screen endwise, and as they slide down the chute to the catch pan the waste material passes out at the lower end of the roll.

A grain cleaner 24 inches wide, equipped with sieve frames for wheat, is used as a basis for the separator. The bottom sieve frame of the shaker unit is partially covered with an 80- by 56-mesh screen having a wire 0.00575 of an inch in diameter.[1] This mesh is suitable for eggs of Aedes aldrichi Dyar and Knab and A. vexans Meig. It may also be used for eggs of A. dorsalis Meig., although it is slightly large. This screen is attached at the upper edge of the frame and extends an inch or two past the waste opening shown in the diagram (fig. 1). The second sieve frame from the bottom is clothed with 40- by 40-mesh screen. The tin which covers the lower end of this frame is removed, and a piece of tin forming a trough is attached instead, as shown in the illustration (fig. 2). This tin is $8\frac{1}{2}$ inches in width at one end and $18\frac{1}{2}$ inches at the other. At the broad end the tin is allowed to extend out about 2 inches past the edge of the machine. The lower 2 inches of the tin is bent upward to form the trough. The tin is then bent down along the edge of the screen frame to carry off the waste coming from the three top sieves and to prevent it from being mixed with the material blown out by the fan. This will permit examination of the fan waste for eggs and adjustment of the fan doors and wind damper. The third sieve frame from the bottom is clothed with 30- by 30-mesh screen and the top frame is clothed with 14- by 14-mesh screen.

The mill is equipped with one center roll. Deflector plates are needed to direct the material into the roll. The size of the screen on this roll will, of course, depend upon the size of the eggs to be recovered. A 60- by 60-mesh screen having a wire 0.00675 inch in diameter is used for eggs of Aedes aldrichi, A. vexans, and A. dorsalis.

The machine may be operated by hand power with a crank. However, a motor is desirable if large quantities of soil are to be handled. If a motor is to be used, the mill should be equipped with belt pulleys. A $\frac{1}{4}$-horsepower electric motor having a speed of 1,750 revolutions per minute provides suitable power.

A base for the motor is provided by fastening a 9- by $1\frac{1}{4}$-inch board over the top of the hopper with four bolts (3/16 by 12 inches) from which the heads have been removed. These are bent to hook around the frame of the machine, as shown in the illustration.

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[1] The roll screen, deflector plates, motor pulleys, and sieve frames with the screens required may be obtained from the company manufacturing the grain cleaner.

The motor is then bolted to the board with four carriage bolts of suitable size.

The waste opening shown in the diagram is made by cutting the tin fastened to the bottom of the shaker unit. The cut is made across the width of the machine $2\frac{1}{4}$ inches from the edge of the board to which the lower margin is fastened. When the $2\frac{1}{4}$ inches of projecting tin is bent down along the edge of the board, it provides a waste opening and an apron which prevents soil particles from being thrown forward into the hopper leading to the roll screen. Through this waste opening soil particles that are smaller than the eggs are eliminated after passing through the 80-mesh screen above. A waste pan, shown in the diagram, is provided to receive this soil. The pan extends across the width of the machine and is $2\frac{1}{4}$ inches deep, 4 inches wide at the bottom, and 8 inches wide at the top. It may be made of a good weight of galvanized tin with wooden ends, or from other suitable material.

A support for an egg-catching chute below the roll screen is provided by fastening two 2- by 2-inch pieces parallel with the roll. The top edges of these two pieces are 8 inches apart and are equidistant from the middle of the frame to which they are attached. The ends of these pieces are notched at a slight angle and fastened to the frame of the machine, as shown in the diagram and illustration.

The forward chute may be made by fastening one piece of tin 20 inches wide and 28 inches long to the 2- by 2-inch support. The upper end of this tin is even with the outside edge of the cross frame of the mill; the lower end is $2\frac{3}{4}$ inches from the floor. Under the lower end of the cylinder a piece of tin 11 by 28 inches is attached to the supports. This piece is $\frac{3}{4}$ inch from the cross frame of the mill at the top, and $2\frac{3}{4}$ inches from the floor at the bottom end. The corners of the two tin pieces which extend above the 2- by 2-inch supports are trimmed off parallel with the roll, as shown in the diagram, before the tin pieces are attached with nails.

The wind blast generated by the fan in this machine is powerful. Therefore doors must be provided to close the openings partially on both ends of the fan drum, as shown in the illustration. The door on the motor side will fit snugly against the end of the fan drum. On the opposite side, however, a gear on the fan shaft extends into the opening. To provide a surface against which this door may be clamped, two pieces of board $\frac{1}{2}$ inch thick should first be nailed to this end of the fan drum. These pieces should extend in the form of a right angle from the top of the opening. The doors may be made from 12- by $7\frac{1}{2}$-inch pieces $\frac{1}{4}$ inch thick. An opening $1\frac{1}{2}$ inches wide is cut out over the fan shaft. A nail

driven into the end of the drum at the forward end of the board is bent over to hold this end in place. A slot is cut in the other end of the board and a hole drilled through the end of the fan drum. A carriage bolt with thumb nut and washer then provides a clamp which will hold the board open at the end to the desired distance.

Satisfactory results were obtained with the fan doors on the motor side open $\frac{3}{8}$ inch at the clamp end. The door on the opposite side is opened a little wider to compensate for the gear which obstructs part of the notched opening. With the wind board adjusted so that the edge is flush with the frame and the wind damper opened three notches, only a small percentage of the eggs are lost by being blown over. The material blown over can be examined and these features adjusted to suit the operator's needs.

Coarse material is removed from the soil before it is put through the machine. This may be done with a sieve having about an 8 by 8 mesh. Before the soil is put through the machine it should be dried until it is almost dusty.

The separator recovers about 90 percent of the eggs from this soil. By running the waste through several times nearly 100 percent of the eggs can be recovered. The soil which comes through the mill with the eggs may be put through again, with the loss of only a small number of eggs and elimination of considerable soil. The final product usually contains from 10 to 200 eggs per cc of material. The concentration will depend of course upon the species and the location. In the Lower Columbia River Valley the average number of eggs of Aedes vexans and A. aldrichi is about 85 per cc.

To prevent the eggs from drying out, the product should be moistened with from 8 to 15 cc of water per 100 cc of material, depending upon the type of soil.

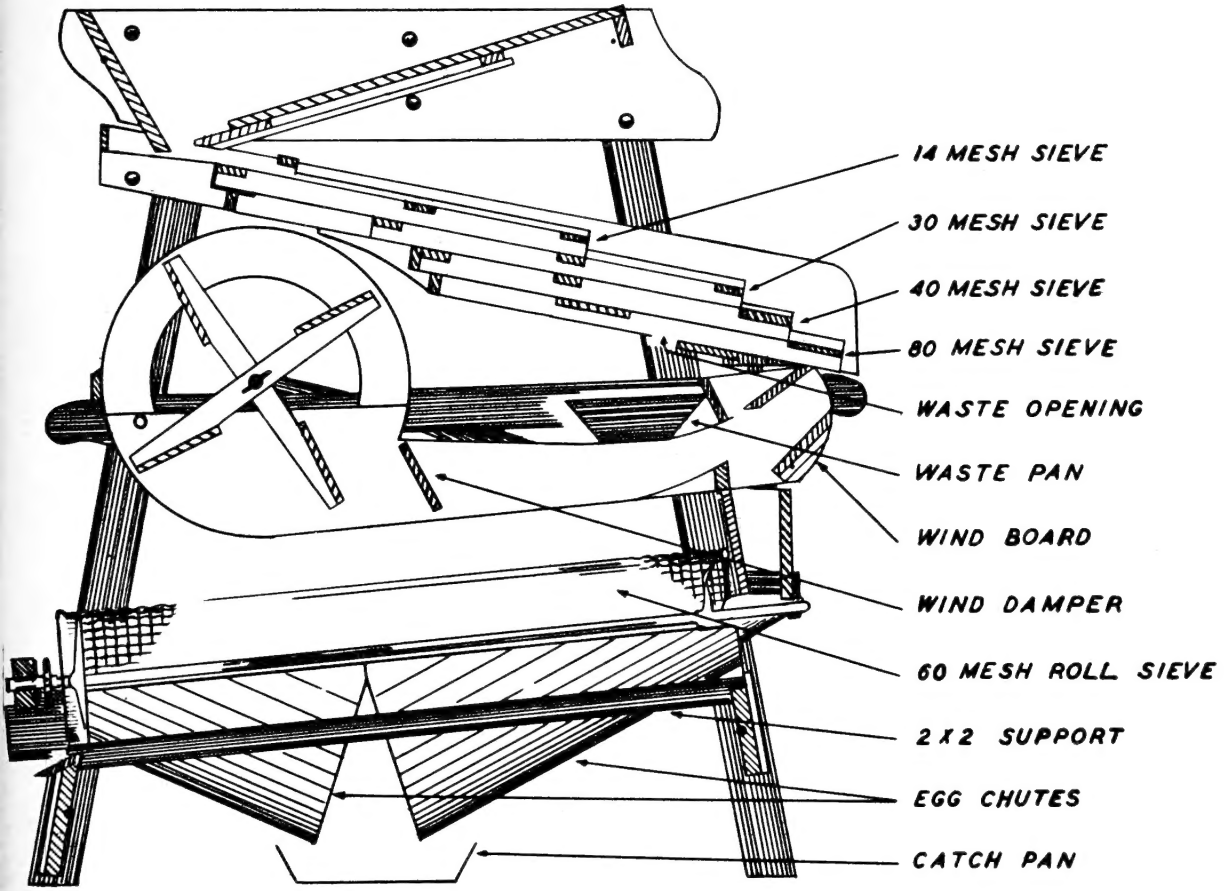

Figure 1.--Diagram of parts of the machine used for separating mosquito eggs from soil.

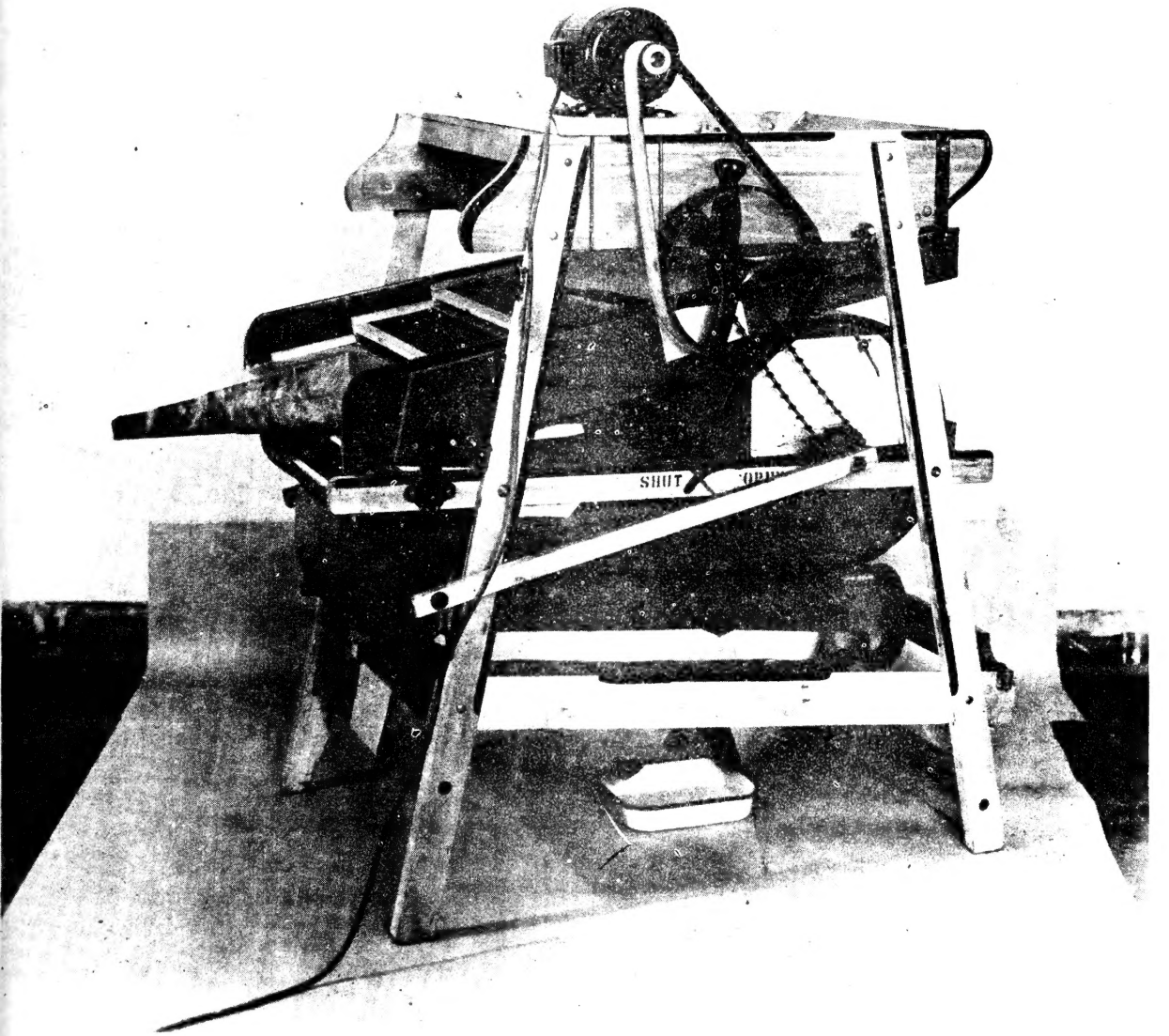

Figure 2.--Machine for separating mosquito eggs from soil.